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PYROMETRY.—*The proper type of absorption glass for an optical pyrometer.* PAUL D. FOOTE, F. L. MOHLER, and C. O. FAIRCHILD, Bureau of Standards.

On account of the deterioration of the filament of the standard lamp used in the Holborn-Kurlbaum form of optical pyrometer the maximum temperature at which the instrument may be safely operated is about 1400° or 1500°C. For the measurement of higher temperatures the intensity of the light entering the pyrometer is decreased by means of an absorption glass or sectored disk. If strictly monochromatic light were employed, the following relation resulting from Wien's law would apply to measurements made with the diminished intensity:

$$\frac{1}{\theta} - \frac{1}{S} = \frac{\lambda \log_e T'}{C_2} = A$$

where θ is the true absolute temperature of the black-body source, S the measured absolute temperature for the wave length λ, and $T' = f(\lambda)$, the transmission of the absorption glass or sectored disk for the wave length λ. Under such conditions A is a constant with respect to θ. However, as one of the writers[1] has shown, A is by no means in general a constant when the light is not absolutely monochromatic, this condition being the one experimentally obtained by the use of red glass screens, and of chief interest in optical pyrometry. The object

[1] FOOTE. Bur. Stds. Sci. Paper No. 260. 1916.

of the present note is to describe an absorption glass for which the quantity A would be independent of the temperature of the black-body source.

When the light is not monochromatic, the simple equation above can not be employed. With heterochromatic conditions, the setting of the pyrometer is correct when the luminosity of the black-body source as viewed through the lens and absorption-glass system exactly equals the luminosity of the standard lamp as viewed through its lens and absorption-glass system. The condition for a match is as follows:

$$\int_0^\infty T T' V J\ (\lambda, \theta)\, d\lambda = \int_0^\infty T V J\,(\lambda, S)\, d\lambda \qquad (1)$$

where $T = f\ (\lambda)$ is the transmission of the red glass screen usually employed, $V = f\ (\lambda)$ = visibility, $J\ (\lambda, \theta)$ the intensity relation as given by Wien's law for the black-body source, $J\ (\lambda, S)$ the similar relation for the lamp, and λ, S, and T' have the significance noted above. This assumes that the lamp radiates as a black body and that the absorption due to the various lens surfaces is negligible, but the method for deriving the proper form of $T' = f(\lambda)$ is the same when these factors are considered.

Let T' have the form $T' = e^{\frac{\alpha C_2}{\lambda}}$ where α is a negative constant. Equation (1) may be rewritten thus:

$$\int_0^\infty T V C_1 \lambda^{-5} e^{-\frac{C_2}{\lambda}\left(\frac{1}{\theta} - \alpha\right)} d\lambda = \int_0^\infty T V C_1 \lambda^{-5} e^{-\frac{C_2}{\lambda S}} d\lambda \qquad (2)$$

In order that (2) be true it is necessary that:

$$\frac{1}{\theta} - \alpha = \frac{1}{S}, \quad \text{or} \quad \frac{1}{\theta} - \frac{1}{S} = \alpha \qquad (3)$$

Whence, if the transmission of the absorption glass has the form $T' = e^{\frac{\alpha C_2}{\lambda}}$, we have $\frac{1}{\theta} - \frac{1}{S} = A = \alpha =$ a constant independent of the temperature.

Thus, using an absorption glass of this type, it is possible to calibrate the glass at temperatures less than 1500°C., i.e.,

below the point where the safe operation of the pyrometer lamp is in question, and to use this experimentally determined value of A for *extrapolation of the temperature scale without the necessity of applying corrections for change of A with θ.*

Such a glass is ideal for other reasons. There will be always a perfect color match between the black-body furnace and the pyrometer lamp. This becomes evident upon considering intensities at any monochromatic wave length. We have for a match at wave length λ

$$J(\lambda, \theta)\ T' = J(\lambda, S) \tag{4}$$

or

$$\lambda \log_e T' = C_2\left(\frac{1}{\theta} - \frac{1}{S}\right) \tag{5}$$

Since by the assumed form of T' the quantity $\lambda \log_e T'$ is constant, $\frac{1}{\theta} - \frac{1}{S}$ is constant, and a match for one wave length holds for all other wave lengths. Also this condition of color match holds for all other temperatures.

As a consequence of the above fact, the settings made with this type of absorption glass are absolutely independent of the type of red glass ocular used. The same settings are obtained for a red glass, a blue glass, or no-colored glass ocular at all. The settings are independent of the visibility curve of the observer and a color-blind person would obtain the same readings as the normal observer. With the usual type of absorption glass or sectored disk we do not have a color match and settings are therefore difficult to make; different observers obtain different values of A on account of differences in their visibility curves; and the variation of A with θ, which must be accurately known for accurate temperature measurement, is very difficult to determine experimentally.

In order to check the constancy of A with θ luminosity curves were drawn for each system, viz., lamp + red glass and furnace + black glass + red glass, and comparisons made by use of equation (1). The quantity A was found to be constant within the errors of the necessary graphical integrations. Another

means of showing this is as follows. Let equation (1) represent the condition for any system whatever, that is, one in which, in general, $A = f(\theta)$. On dividing (1) by its derivative with respect to θ, and substituting $\frac{1}{\theta} - \frac{1}{S} = A(\theta)$ we obtain:

$$\frac{dA}{d\theta} = \frac{\lambda(S) - \lambda'(\theta)}{\theta^2 \lambda'(\theta)} \tag{6}$$

Where $\lambda(S)$ is the effective wave length of the system lamp at temperature S + red glass, and $\lambda'(\theta)$ is the effective wave length of the system furnace at temperature θ + absorption glass + red glass.[2]

For the case under consideration $\lambda(S) - \lambda'(\theta) = 0$. The values obtained by graphical integration are given in table 1 together with similar values for the type of absorption glass ordinarily used. It is seen that $\frac{dA}{d\theta} = 0$ within the errors of computation for the new type of absorption glass, while it is far from zero for the Jena glass F3815.

TABLE 1

VALUES OF $\frac{dA}{d\theta}$ FOR JENA GLASS AND NEW ABSORPTION GLASS, USING RED GLASS OCULAR JENA 2745

TEMPERATURE	$-\frac{dA}{d\theta} \times 10^{10}$	
θ	Jena F 3815	New glass; $\alpha = 0.000227$
degrees abs.		
1400	69	±0
2000	29	+2
2400	19	−0.5
3000	11	−0.2

Preliminary work indicates that the absorption glass can be experimentally obtained, to a sufficient degree of approximation, by the combination of black and colored glasses.

[2] Cf. FOOTE. Loc. cit.

In a further note another absorption glass will be described for use with a tungsten-filament pyrometer lamp: a glass such that its transmission requires an invariance of A with θ for all practical purposes, taking account of the loss of light at lens surfaces and the emissivity of tungsten.

GEOLOGY.—*An andalusite mass in the pre-Cambrian of the Inyo Range, California.*[1] ADOLPH KNOPF, Geological Survey.

The andalusite mass here described is in southern Mono County, California, 4 miles east of Milner station on the Nevada and California Railroad. It is in the northern part of the Inyo Range, or as this part of the range is known locally, the White Mountains, and is at an altitude of 7500 feet, about 3000 above the floor of Owens Valley.

GENERAL GEOLOGY

The rocks exposed along the trail that leads from the base of the range to the andalusite mass consist largely of argillite, more or less slaty, and schistose conglomerate. They form a belt more than 10,000 feet wide, of which the conglomerate is roughly estimated to make up one-third. The strata stand at high angles, generally vertical, so that their thickness is roughly measured by the width of the belt, but they have probably been repeated by faulting.

The conglomerates are composed mainly of fragments of fine-grained quartzite. Many of the pebbles, which range up to 12 inches long, are well rounded, but the smaller pebbles are generally angular. Pockets and irregular lenses of conglomerate are irregularly intercalated in argillitic strata, and the pebbles in these intercalated lenses are unsorted and unshingled, the longer axes of contiguous pebbles commonly standing at right angles to one another. These features suggest a fluvial origin for the great series of strata lying west of the andalusite mass.

[1] Published with the permission of the Director of the U. S. Geological Survey.

The andalusite mass is bordered on the north and northeast sides by schistose volcanic porphyry and breccia characterized by widely scattered phenocrysts of plagioclase. East of the main andalusite body are outcrops of other considerable masses of similar andalusite rock, but more mixed with other minerals, and associated with these in thick beds are some brilliant white rocks, soft and composed almost wholly of flakes of muscovite.

The age of these rocks is in all probability pre-Cambrian. This conclusion is based on what is known of the structure and stratigraphy of the portion of the Inyo Range to the south.[2] The sedimentary rocks to the south range from pre-Cambrian to Triassic, all the intervening systems being represented except the Silurian. They aggregate in thickness more than 36,000 feet, but in all this great assemblage there are no rocks that resemble those associated with the andalusite mass. They are in general less metamorphosed, except perhaps the oldest pre-Cambrian rocks recognized; they are not notably conglomeratic; and they are of marine origin. In the northern part of the Bishop quadrangle, which is only 8 miles south of the andalusite deposit, Cambrian and pre-Cambrian strata, intruded by Cretaceous granite, make up the range. The pre-Cambrian consists of dolomite, sandstones, and dolomitic limestones; of these the massive Reed dolomite, 2000 feet thick, is the most readily recognizable formation. Rocks of this kind do not occur near the andalusite mass, and it is probable, therefore, that the rocks inclosing it are of still older pre-Cambrian age than those in the Bishop quadrangle.

THE ANDALUSITE MASS

The andalusite mass is well exposed, owing to the ruggedness of the region. It is certainly more than 300 feet wide at its maximum and is 500 feet long; and, as shown by the deep

[2] KNOPF, ADOLPH. *A geologic reconnaissance of the Inyo Range and the east slope of the southern Sierra Nevada*, with a section on *The stratigraphy of the Inyo Range*, by Edwin Kirk. U. S. Geol. Survey Prof. Paper 110 (in course of publication).

canyon on the north and by the cliffs on the west, it extends to a depth of at least 300 feet.

On the east side of the mass is a great body of coarse milk-white quartz, which in places is as much as 50 feet wide. Veins and stringers of this quartz penetrate the andalusite mass for long distances. It is notable that the narrower stringers of quartz carry considerable quantities of the deep-blue mineral lazulite; muscovite also is common in the quartz but is not abundant; and specular hematite is locally abundant. The lazulite, a hydrous phosphate of aluminum, magnesium, and iron carrying about 45 per cent of P_2O_5, is of course a striking constituent, because of its uncommon and intense color, and in fact it was the presence of this mineral that led to the discovery of the andalusite mass. The prospector who found the lazulite thought it was bromide of silver, but when an assay showed that it contains no silver, his interest in it vanished. Later, others located and staked the andalusite mass, under the belief that the great body of brown rock traversed by the lazulite-bearing quartz veins is apatite.

Andalusite rock, consisting wholly of coarsely granular andalusite and free from quartz stringers, occurs on the northwest side of the deposit. The texture of rock of this kind ranges from coarsely granular or radial columnar to roughly schistose. The schistose structure is more and more well-defined toward the east border and is due to the increasing amounts of quartz and finely flaky muscovite that occur with the andalusite. The andalusite-bearing rock probably grades into the volcanic porphyry on the east. Under the microscope the andalusite is found to have the normal optical properties of that mineral. In habit it is notably poikilitic and spongiform where much quartz is present, and in such places the anhedrons of andalusite inclose large numbers of quartz grains. Dr. W. T. Schaller has measured the refractive indices of the mineral, finding them to be: $\gamma = 1.642$, $\beta = 1.635$, and $\alpha = 1.631$. Moreover chemical examination by Dr. Schaller shows that the mineral contains only alumina and silica; and the identity of the mineral as andalusite is therefore fully established.

The occurrence elsewhere of so extensive a mass of andalusite rock as that in the pre-Cambrian of the Inyo Range appears to be unknown. It is provisionally suggested that the andalusite mass originated from the volcanic porphyry through pneumatolytic metamorphism sequent upon the granitic intrusions that occur in the range. Since examining this andalusite rock the writer has had occasion to study in detail closely similar andalusite rock in the Rochester district, Humboldt County, Nevada, where a pneumatolytic origin is unmistakable. A series of Triassic rhyolites is cut by a network of dumortierite veinlets carrying sporadic tourmaline, and the intervening rock has been altered to an aggregate of quartz and poikilitic andalusite, in places carrying considerable dumortierite ($Al_8HBSi_3O_{20}$), a mineral closely related to andalusite. This metamorphism closely followed the intrusion of post-Jurassic, probably Cretaceous, granitic rocks. Andalusitic alteration of Tertiary lavas, an alteration which evidently took place under conditions of lower temperature (under "hydrothermal" conditions) than those indicated for the California and Nevada occurrences, has been described by Butler.[3] who pointed out that metamorphism of this kind had not previously been recorded.

GEOLOGY.—*A new area of Carboniferous rocks with some coal in the north end of the Gulf embayment.*[1] EUGENE WESLEY SHAW, Geological Survey.

The geologic maps of the southern end of Illinois and adjoining territory show the area of Cretaceous and later deposits known as the Gulf or Mississippi embayment as extending northward across one row of counties in Illinois and terminating at a more or less regular line convex to the north, along what was formerly a portion of the valley of the Ohio. On the north side of this abandoned valley is the range of hills of Paleozoic rocks that crosses southern Illinois from the Ozarks at Sainte Gene-

[3] BUTLER, B. S. *Geology and ore deposits of the San Francisco and adjacent districts, Utah.* U. S. Geol. Survey Prof. Paper 80: 78–82. 1913.

[1] Published by permission of the Director, U. S. Geological Survey.

vieve and Commerce, Missouri, to Shawneetown and Golconda, Illinois. The various formations of the Gulf embayment have concentric areas of outcrop, the oldest extending farthest north, and, according to the maps, terminating rather abruptly, as though the south side of the range of hills were a cliff cut by the waves of a Cretaceous sea. The general arrangement of outcrops of the Paleozoic formations is also concentric but convex to the south, so that the outcrops of the older formations are nearest the Gulf embayment.

The Provisional Geologic Map of Illinois, compiled by Stuart Weller[2] and published in 1906, represents the Gulf embayment deposits in Illinois as consisting of Tertiary (possibly including some Cretaceous) shales, fire clays, sands, and gravel, and the northern border is along the middle of the abandoned Ohio valley, except that at the east end it curves south through Temple Hill and Rosebud to the present channel of the Ohio at New Liberty (all villages in southern Pope County) and at the west it curves south through Tamms to Santa Fe.

In the same year Glenn[3] published a map that shows all of the Gulf embayment area in Illinois as Cretaceous except the southern part of Alexander and Pulaski Counties just north of Cairo. The northern boundary is roughly similar to that on Weller's and other earlier maps but slightly more wavy. A little south of the middle of Alexander and Pulaski counties is an east-west belt of Porters Creek (Eocene), about 3 miles wide and slightly convex to the north; and south of this belt, these counties are, according to this map, underlain by LaGrange (Eocene).

The geologic map of North America by Willis and Stose[4] is similar to that of Glenn except that the two Eocene formations are grouped together.

[2] WELLER, STUART. *The geological map of Illinois.* Illinois State Geol. Survey Bull. 1. Pp. 26 and geol. map. 1906.

[3] GLENN, L. C. *Underground waters of Tennessee and Kentucky west of Tennessee River and of an adjacent area in Illinois.* U. S. Geol. Survey Water-Supply Paper **164**: Pl. 1. 1906.

[4] WILLIS, BAILEY, and STOSE, G. W. Geologic map of North America. Scale 1: 5,000,000, U. S. Geol. Survey in cooperation with Canada Geol. Survey and Inst. Geol. de Mexico, 1911. Published also in U. S. Geol. Survey Prof. Paper 71, in 4 sheets and in separate case, 1912.

A later map of Illinois[5] represents the Gulf embayment deposits in Illinois, except the Quaternary alluvium, by one color, the heading in the legend being "Cretaceous-Tertiary." The northern boundary is more irregular than on earlier maps and some Paleozoic rocks ("Lower Mississippian") are shown on the south side of the abandoned portion of the Ohio Valley.

It may be remarked incidentally that only two of the maps referred to show the deposits in this old valley and they do not show them as connected through to the east or east-southeast with the recent alluvium of the present course of the Ohio, though in fact the deposits and the abandoned valley run from the present channel of the Ohio westward without interruption to the present channel of the Mississippi.

With the exception of Glenn's map, which does not differentiate the Paleozoic, the various maps show the southern limit of Pennsylvanian strata as trending in general east and west through the northern part of the second row of counties north of the Ohio (Union, Johnson, Pope, and Hardin). The latest and most detailed map of this region shows a belt of "Upper Mississippian" rocks occupying the middle and southern portions of these counties, with some "Lower Mississippian" on the south, some small areas of Devonian in the eastern part (west-central Hardin County), and some Devonian, Silurian, and Ordovician on the west and southwest extending to the present channel of the Mississippi opposite Commerce, Missouri.

Earlier descriptions, particularly those of Worthen and Engelmann,[6] accord with the geologic maps later published. All indicate southward-dipping Mesozoic and Cenozoic rocks in the southern row of counties and northward-dipping Paleozoic rocks in the country to the north, the southern limit of the Pennsylvanian, or coal-bearing formations, being some distance north of the Gulf embayment. The deposits in the embayment thus lap over a part of the outcropping edges of the Ordovician, Silurian,

[5] Illinois State Geol. Survey, Provisional geologic map of Illinois. Scale 1:500,000. 1912.

[6] WORTHEN, A. H. *Geology*. Geol. Survey of Illinois, vol. 1. 1866. Contains geology of Pulaski and Massac counties by Henry Engelmann, pp. 410–455.

Devonian, and Mississippian formations, the oldest deposits of the embayment extending farthest north and lying upon the youngest Paleozoic beds. Among themselves, the embayment formations, according to published descriptions, off-lap the youngest outcropping farthest seaward and along the axis of the embayment, and the oldest around the margins, or landward edge of the area.

The maps and descriptions indicate that central and southern Massac County, Illinois, the second county up the Ohio River from Cairo, is underlain by southward and southwestward dipping Cretaceous and Tertiary beds that rest upon the eroded edges of formations belonging for the most part far below the top of the Mississippian series, and that the northern part is occupied by outcrops of "Lower" and "Upper Mississippian" formations and Quaternary deposits. The maps show that a few miles to the east of the county is an area of Mississippian rocks bordering Ohio River.

It was therefore somewhat of a surprise to find a few years ago, while the writer was doing some work in the section of Coastal Plain Investigations, U. S. Geological Survey, outcrops of coal-bearing rocks in eastern Massac County, and to find also some of the immediately underlying Mississippian strata. The outcrops, which occupy several square miles in the vicinity of Oliff, were unexpected, both because the region is shown on maps as being underlain with Mesozoic and Cenozoic formations, and because according to available information the southern limit of the Pennsylvanian, or coal-bearing rocks, is many miles to the north, their horizon in Massac County being, to judge from the maps, far above the present surface. However, it should be remarked that not many miles to the east in Kentucky are some small outliers of coal-bearing rocks.

This small coal basin and the outcropping rocks of the Chester group in the surrounding area are of especial interest, for they furnish new information on the areal, economic, and structural geology and on the physiography of the region.

They show that Pennsylvanian and uppermost Mississippian beds occur a good many miles south of the previously known

outcrops of such beds in Illinois and also some distance west of the previously known outcrops of such strata in Kentucky. In the Paleozoic limestone beds outcropping around the area of coal five collections of fossils were made and submitted to Dr. George H. Girty for identification. He reports as follows:

The five collections whose species are listed below contain essentially the same faunas and are without doubt of Chester age. They remind me strongly of some of my collections from the Clore limestone and, taking into consideration all the evidence that you have, I believe that they are in fact really Clore. Our knowledge of the faunas of the different subdivisions of the Chester group is not, however, sufficient to justify a positive statement.

Lot 634

10 miles northeast of Brookport, Illinois, Chandler farm.

Batostomella spinulosa?
Meekopora approximata
Stenopora aff. cestriensis
Polypora aff. spinulifera
Fenestella tenax
Archimedes proutanus var.
Productus pileiformis
Diaphragmus fasciculatus
Spirifer increbescens
Spiriferina transversa
Spiriferina spinosa?
Composita? sp.
Cliothyridina sublamellosa
Eumetria marcyi

Lot 635

Lower prospect for lead and fluorspar (20 feet stratigraphically below bed containing 635 A) on Chandler farm, 2 miles northeast of Oliff, Illinois, and 10 miles by road northeast of Brookport, Illinois.

Stenopora aff. cestriensis
Batostomella? sp.
Streblotrypa? sp.
Fenestella tenax
Diaphragmus elegans
Spirifer pellensis?
Composita subquadrata
Eumetria Marcyi
Primitia sp.

Lot 635 A

Upper prospect, Chandler farm, 10 miles by road northeast of Brookport (7 miles direct), southwest of Chandler house.

Triplophyllum sp.
Streblotrypa nicklesi
Fenestella tenax
Polypora aff. spinulifera
Archimedes proutanus var.
Stenopora aff. cestriensis
Batostomella sp.
Meekopora approximata
Spirifer increbescens
Spiriferina transversa
Composita subquadrata
Eumetria vera

Lot 636

Ford of small stream 1 mile northeast of Oliff, Illinois, and 10 miles by road northeast of Brookport; altitude 370 ±.

Pentremites symmetricus	Streblotrypa nicklesi
Pentremites sp.	Cystodictya pustulosa
Stenopora sp.	Dielasma? sp.
Polypora sp.	Cliothyridina sublamellosa
Fenestella tenax	Composita sp.

Lot 637

Near house, Chandler farm, 10 miles by road northeast of Brookport, side of sink hole.

Meekopora approximata	Spirifer pellensis?
Stenopora aff. cestriensis	Composita subquadrata
Batostomella sp.	Eumetria vera
Productus ovatus	Bellerophon sublevis
Diaphragmus elegans	Sphaerodoma? sp.

A careful search was made for fossils that might indicate the exact age of the coal, but although several fragments of plant remains were found, they were not sufficient to identify the bed. The beds above and below consist mainly of sandstone, commonly cross-bedded, and the true beds range from a few inches to many feet in thickness. The peculiar "gnarly" aspect of the clay and sandy shale associated with the coal, the character of the sandstone, particularly the scarcity of mica flakes, and the proximity of limestones belonging in the Chester group, point to a Pottsville age for the coal. Perhaps it is Mercer, for the coal and associated beds resemble a coal identified by David White as belonging in that member at Murphysboro and elsewhere.

The economic significance of the discovery is probably not great because the coal underlies only a small area, its thickness is not more than a foot or two, and it is not of a very high grade. The definite knowledge concerning it has been obtained from two small outcrops and nearby abandoned prospects located near the county line in the SW.¼, Sec. 16, T. 15 S., R. 6 E. The coal may have an extent of only a few acres or it may underlie considerable parts of several sections and possibly a large area in the Gulf embayment. Its thickness at the exposures and prospects is 10 to 22 inches; possibly thicker coal may be

found nearby. Although the quality is fairly good and no other sources of coal are within 20 or 30 miles, the facts now at hand would not warrant extensive prospecting. A few tons of coal have been mined and are reported to have burned very satisfactorily. Most of it was used in houses, but some is said to have been tested on a small river steamer. This coal should not be confused with brownish lignite, such as occurs a few miles to the south in the Cretaceous and Tertiary formations of the Gulf embayment and is not at present of much economic value.

Although the coal may not have a great extent or thickness, it is worth noting that here is an area of Pennsylvanian coal not described or included in any of the discussions of the coal resources of the United States. The coal in places is no doubt workable under present conditions, is almost certain to prove of some value as the richer supplies of the country are exhausted, and may lead to the discovery of more extensive concealed deposits. The outcrop is about 7 miles northeast of Brookport, only 4 miles from the Ohio River, and far south of the main coal-producing region of Illinois.

The new data show that the general structure of the Paleozoic rocks in the southern end of Illinois is not monoclinal and northward dipping, with faults and modifying folds here and there, as one would infer from the available geologic maps. Instead it approaches a general anticlinal form. Beds that at McLeansboro, near the middle of the great Eastern Interior coal basin, lie 2,000 feet below the surface and several hundred feet below the formations containing the main coal beds, rise southward and outcrop north of Massac County, and it has been supposed that still older formations are concealed beneath the Gulf embayment deposits. It is now found, however, that not only are the bedrocks under these Cretaceous and Tertiary deposits exposed in eastern Massac County, but that they belong rather high among Paleozoic rocks, being in part upper Mississippian and in part basal Pennsylvanian.

The finding of outliers of Paleozoic rocks in the upper end of the Gulf embayment in Massac County and elsewhere, together with the fairly definite determination of the slope of the Paleo-

zoic floor upon which the deposits of the embayment rest and the determination of the slope of peneplain in the territory immediately to the north, show that the upper end of the Gulf embayment is not terminated by an ancient sea cliff, but that the peneplain buried underneath the Cretaceous rises to the north, becoming gradually less distinct, and in a few miles is apparently intersected by a peneplain of later date.

The surface of the Paleozoic rocks where exposed in Massac County is the hard-rock floor upon which the Cretaceous and Tertiary deposits of the embayment rest, and is thus a part of the ancient peneplain that has been buried for several periods and has only recently been exposed and slightly cut into. The altitude of this old peneplain is here 370 to 400 feet, as determined by aneroid measurements, and the slope is about 30 feet to the mile. These determinations accord with what is known of the altitude and slope of this surface as determined from numerous outcrops and well records in the surrounding region.

Gravel and some less enduring material believed to belong with the embayment deposits are found in numerous places on the north side of the abandoned valley of the Ohio, and it is evident that the embayment deposits once extended considerably north of their present northern limit. There is some indication that they may once have extended north of the low range crossing the southern end of the state, 40 miles or more north of the river. Some hills of peculiar, slightly coherent, poorly sorted sandstone in the lowlands north of the range, as for example near West Franklin, near Baldwin, and elsewhere, may possibly be outliers of Gulf embayment deposits far north of any beds yet recognized as belonging with them. The sandstone contains in places angular fragments more than $\frac{1}{4}$ inch in diameter, and in this and other respects does not resemble sandstone of the same region known to be of Pennsylvanian age. It is, if anything, more like slightly cemented glacial outwash, but differs from that material in that it seems to contain no pebbles from Canada, and in other respects it is not similar to the washed glacial deposits of the region. The fact that the peneplains in the range of hills seem to slope southward, though at a

somewhat less rate than the dip of the rocks, and that there is good reason for believing that erosion has been acting continuously on southern Illinois, with the exception of those times and areas when and where deposition was not in progress, seems to accord with the inference that deposits of the embayment or Coastal Plain possibly once extended far north of their present limits. In any case it is evident that the northern border of these deposits is now being driven southward and that the surface features along the southern side of the range of hills are those of a peneplain that has been long buried and only recently uncovered, and which, as shown by outcrops and well records at Brookport, Metropolis, Cairo, and other places, slopes southward 28 to 32 feet to the mile.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this JOURNAL and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*The reflecting power of tungsten and stellite.* W. W. COBLENTZ and W. B. EMERSON. Bureau of Standards Scientific Paper No. 308 (Bull. Bur. Stds., **14**: 307–316). 1917.

The reflecting power of tungsten and stellite in the region of the spectrum from 0.5μ to 6μ was determined by comparison with silver, and by a new method employing a total reflecting prism. Four samples of tungsten in the form of plane, highly polished mirrors were examined. The reflectivity of tungsten rises abruptly from 50 per cent at 0.5μ to 90 per cent at 2μ.

All samples of tungsten show sharp indentations at 0.8μ in the reflectivity curve. A similar indentation occurs at 1.3μ in the reflectivity curve of the pure metal, but not in an impure sample. The application of these data to the question of increasing the luminous efficiency is discussed.

The reflecting power of stellite rises from 65 per cent in the visible spectrum to 88 per cent at 9μ. W. W. C.

PHYSICS.—*Standard samples for thermometric fixed points.* Bureau of Standards Circular No. 66. Pp. 19. 1917.

This circular describes the methods of preparation and the chemical analyses of the metals tin, zinc, aluminium, and copper, which have been prepared by the Bureau of Standards for distribution.

The melting points of these materials were determined with platinum resistance thermometers, and will serve to define accurately certain fixed points of the temperature scale so that they may be used for the calibration of pyrometers, the samples distributed being sufficient in amount (about 50 cm.^{3}) for this purpose.

The metals are all of American manufacture and are probably of as high a degree of purity as has been attained in the preparation of relatively large amounts of such materials. The chemical analyses show purity as follows: zinc, 99.993 per cent; tin, 99.988 per cent; copper, 99.987 per cent; aluminium, 99.68 per cent. B. S.

MAGNETISM.—*An experimental study of the Fahy permeameter.* CHARLES W. BURROWS and RAYMOND L. SANFORD. Bureau of Standards Scientific Paper No. 206 (Bull. Bur. Stds., **14**: 91–159). 1917.

This permeameter was developed during the course of an investigation at the Bureau of Standards of the magnetic-mechanical properties of steel. In order to ascertain the degree of accuracy attained, as well as its fitness for general laboratory use, a critical experimental study of the instrument in its present form has been made. The instrument represents a distinct advance in the measurement of the magnetic characteristics of steel and other magnetic materials. In accuracy it far excels the direct-reading permeameters which have been rather commonly used both in this country and abroad. Normal induction measurements of solid bars show errors no greater than 5 per cent of the magnetizing force required for the given induction. The consistency of its readings taken at different times on the same specimen is so close that comparative results on similar materials can be obtained to a high degree of precision. Commercial materials, however, are seldom uniform enough to warrant better precision than 5 per cent. Hysteresis measurements are accurate within the limits of commercial requirements and the uniformity of commercial materials. C. W. B.

GEOLOGY.—*The inorganic constituents of marine invertebrates.* FRANK WIGGLESWORTH CLARKE and WALTER CALHOUN WHEELER. U. S. Geological Survey Professional Paper 102. Pp. 56. 1917.

The purpose of this investigation was to determine, more thoroughly than has been attempted hitherto, the character of the contributions made by marine invertebrates to the marine sediments, and therefore to the limestones of oceanic origin, such as shell, coral, crinoidal, etc. Two hundred and fifty analyses were made of the shells or skeletons of organisms ranging from the foraminifera up to the crustaceans, and including, on account of their importance as reef builders, the calcareous algae. Each group of organisms was taken in fairly large series,

and many data are given relative to localities, depths of water, and bottom temperatures. The crustaceans, some brachiopods, some alcyonarians, and a few worm tubes were found to be notably phosphatic, and therefore to be considered in discussing the origin of phosphate rock. The foraminifera, alcyonarians, echinoderms, crustaceans, and coralline algae, with some sponges and bryozoans are distinctly magnesian, and therefore contribute to the formation of magnesian limestone. Mollusks, millepores, and the madreporarian corals have shells or skeletons of nearly pure carbonate of lime. So far as present evidence goes, the presence or absence of magnesia depends upon the nature of the calcium carbonate, whether it is aragonite or calcite. The aragonitic organisms are all, so far as we now know, non-magnesian; all of the magnesian forms are calcitic. Magnesium carbonate is isomorphous with calcite, and goes with its natural partner.

In the magnesian organisms, especially in the series of echinoderms and alcyonarians, a remarkable relation was discovered. In cold water forms the proportion of magnesium carbonate is low, varying from 6 to 9 or 10 per cent, while in organisms from warmer waters it runs much higher, from 10 to 15 per cent. In some algae the percentage of magnesium carbonate in the inorganic portion of the specimens analyzed, was as high as 25 per cent.

In the general discussion at the close of the paper the application of the analyses to the study of coral reefs is considered. F. W. C.

GEOLOGY.—*Baked shale and slag formed by the burning of coal beds.* G. SHERBURNE ROGERS. U. S. Geological Survey Professional Paper 108-A. Pp. 10, 3 plates. 1917.

The baking and reddening of large masses of strata, caused by the burning of coal beds in place, is a striking feature of the landscape in most of the great western coal-bearing areas. In places enough heat is generated to fuse and thoroughly recrystallize the overlying shale and sandstone so as to form natural slag. Some of the slags thus formed resemble igneous rocks both in hand specimen and in thin section but others consist largely of rare and little known minerals. Thoroughly fused slag seems to occur chiefly in crevices or chimneys through which the hot gases generated in the burning escaped through the overlying strata to the surface. It is probable that the ignition of the coal has been due most commonly to spontaneous combustion, especially in places where topographic conditions are favorable.

The report discusses the causes of the burning and its general effects on the overlying strata, and includes petrologic descriptions and photomicrographs of some of the slags formed. An attempt has also been made by means of chemical analyses to explain the mineralogic composition of the slag. As the original rocks are argillaceous rather than calcareous the minerals formed are unlike those common in ordinary furnace slags, and resemble those investigated by Morozewicz in his study of the aluminous magma. G. S. R.

GEOLOGY.—*A comparison of Paleozoic sections in southern New Mexico.* N. H. DARTON. U. S. Geological Survey Professional Paper 108-C. Pp. 25. 1917.

In studying the geology of southern New Mexico, it has been found that various formations of Paleozoic age outcrop extensively in several ranges not previously examined, and many peculiar features of stratigraphy and overlap are presented. Representatives of parts of Cambrian, Ordovician, Silurian, Devonian, and Mississippian time occur. These rocks thin to the north and disappear near latitude 34°, beyond which the Pennsylvanian formations lie on pre-Cambrian granite and schist. The overlap relations of the rocks of the various systems are somewhat complex, and it has not been possible to ascertain to what extent the absence of certain formations is due to non-deposition or to removal by erosion. It was found that the Bliss sandstone, El Paso, Montoya, and Fusselman limestones, Percha shale, and Mississippian limestone are well represented in the San Andres Mountains, most of them extending to its north end. They are also exposed in the great section on the west slope of the Sacramento Mountains southeast of Alamogordo. The El Paso, Montoya, and Fusselman limestones are prominent in the Lake Valley, Caballos, and Cooks Range uplifts, as well as in some of the ranges in Luna County. The formations are remarkably constant in their characteristics and yield many distinctive fossils. N. H. D.

GEOLOGY.—*Oil resources of black shales of the eastern United States.* GEORGE H. ASHLEY. U. S. Geological Survey Bulletin 641-L. Pp. 12. 1917.

It has long been recognized in this country that the time would come when the decline of yield in the oil fields would lead to tests of the black shales as a possible source of oil.

The black shales of the eastern states are mainly at one general

horizon, in the Upper Devonian or possibly in part lower Carboniferous, which extends from New York to Alabama and westward to Mississippi River. Other extensive deposits of black shale occur at one or more horizons in the lower part of the Devonian and at one horizon in the Ordovician. In addition, black shales overlie some of the coal beds, especially certain beds in the eastern interior coal field.

Distillation tests were made on 42 samples of black shale from 7 eastern states. According to these tests the Devonian black shale can be expected to yield not over 10 or 12 gallons of oil, 2,000 cubic feet of gas (as a by-product), and $\frac{1}{3}$ of a pound of ammonia to the ton. Shales that are highly folded yield less oil or none at all.

To give some idea of the amount of oil in this shale, a few figures are given for the body of black shale in southwestern Indiana. It is a very moderate assumption that the yield of this area in southwestern Indiana would be 280,000,000 gallons or nearly 7,000,000 barrels of oil to the square mile, or say 100,000,000,000 barrels for the total area underlain by the shale in southwest Indiana.

At present, interest in the mining of the eastern black shales as a source of oil must confine itself to localities where one of three conditions is met. The shale can be utilized, first, where it outcrops in a position to permit mining on a large scale by steam shovel at a minimum cost; second, where coal that is overlain by bituminous shale is being stripped; and third, where a coal bed that is being mined has a black shale roof that comes down and must be removed from the mine in large amounts. Of these the second condition seems to offer the best opportunity for a trial plant, as the overlying black shale must be removed in mining the coal. R. W. S.

PALEONTOLOGY.—*Fauna of the Mount Whyte formation.* CHARLES D. WALCOTT. Smithsonian Miscellaneous Collections **67**, No. 3 (Cambrian Geology and Paleontology, Part IV): 61–115. 1917.

This paper discusses the localities of the Mount Whyte formation, a name proposed by the writer in 1908 for a series of alternating bands of limestone and siliceous and calcareous shale found in Alberta and British Columbia, Canada, on Mount Whyte, Mount Bosworth, Mount Stephen, and Castle Mountain, to which localities are now added Mount Odaray, Ptarmigan Peak, Mount Shaffer, Yoho Canyon, and Wonder Pass, explored in 1917 and preceding seasons. The *Albertella* fauna, which was previously included, is now found to occur at an horizon 500 feet above the Mount Whyte formation. The

included faunas are discussed and compared with those of other localities with a view of establishing the Lower Cambrian age of the formation, and include 2 new genera, for which *Gogia* and *Shafferia* are proposed, and 29 new species including cystids, brachiopods, trilobites, and a phyllopod. The paper is illustrated by six plates of figures. Further explorations of the present season may throw new light on some of the problems under discussion. G. R. B.

BOTANY.—*The Mexican and Central American species of Ficus.* PAUL C. STANDLEY. Contributions from the U. S. National Herbarium 20, part 1. Pp. 1–35. 1917.

The genus Ficus includes the wild figs, as well as the common cultivated fig, *Ficus carica*. The species are most abundant in the East Indies and Africa, but many occur in tropical and subtropical America, about 50 being known from South America and 33 from the West Indies. In the present paper 41 are recognized from Mexico and Central America, only one of which is found also in the West Indies. The only previous enumerations of the Central American species were published by Liebmann in 1851, by Miquel in 1862, and by Hemsley in 1883. The last author recognized 44 species. From a study of the large amount of herbarium material accumulated in recent years, it has been found that characters relied upon by earlier authors for the separation of species were often of little value, consequently many of the early names have been reduced to synonymy. The genus is represented in Central America by two subgenera, Pharmacosyce, with solitary receptacles and 2 stamens, and Urostigma, with geminate receptacles and one stamen. Eighteen species are described as new, and one new name is proposed. Two of the previously published species were so imperfectly described that it has been impossible to identify them. P. C. S.

BOTANY.—*New or noteworthy plants from Colombia and Central America—6.* HENRY PITTIER. Contributions from the U. S. National Herbarium 18, part 6. Pp. 225–259, pl. 106, figs. 98–104. 1917.

The present paper is a continuation of Mr. Pittier's series of studies of tropical American plants, based chiefly upon his own collections in Central America, Colombia, and Venezuela. In the Moraceae (Mulberry Family), two new species of Coussapoa and four of Cecropia

are published. In the Proteaceae, two new species of Roupala are proposed and an imperfectly known species of Embothrium is redescribed. In an account of the Mexican and Central American species of Combretum, section Micropetalae, 9 species are recognized, 4 of them being new. Seven new species of Cordia are described, besides new species of Schizolobium (2), Platypodium, Andira, Coumarouna, Terminalia (2), Combretum (3), Miconia, Mimusops, Adenocalymna (4), Clytostoma, Lundia, and Jacaranda. P. C. S.

BOTANY.—*The Middle American species of Lonchocarpus.* HENRY PITTIER. Contributions from the National Herbarium 20, part 2. Pp. 37–93, pls. 1–6, figs. 1–43. 1917.

Lonchocarpus belongs to the family Fabaceae (Bean Family), subfamily Dalbergieae. The species are trees or shrubs, and are chiefly American, a few being found in Africa and Australia. In the present paper all the Central American species represented in American herbaria are described, as well as several from the West Indies, Colombia, and Venezuela. The Central American species are arranged in 6 groups, Philenopteri, Spongopteri, Punctati, Epunctati, Concavi, and Carinati. Forty species are recognized, twenty-two of which are new. Two species published in the genus Derris are transferred to Lonchocarpus. Notes upon the habit and ecology of the species are included, as well as a list of the vernacular names asigned to some of them.

P. C. S.

BOTANY.—*Preliminary revision of the genus Inga.* HENRY PITTIER. Contributions from the U. S. National Herbarium 18, part 5. Pp. 173–223, pls. 81–105. 1916.

The genus Inga is a member of the Mimosaceae or Mimosa Family and is confined to tropical America. It was monographed by Bentham in 1875, but the large accumulation of recent material has necessitated a revision of the species. The genus is divided into five sections, Leptinga, with 26 species, Diadema, with 19 species, Bourgonia, with 14 species, Pseudinga, with 117 species, grouped in 8 series, and Euinga, with 36 species, in 2 series. Forty-one species and one subspecies are described as new. P. C. S.

ENGINEERING.—*The use of the panoramic camera in topographic surveying, with notes on the application of photogrammetry to aerial surveys.* JAMES W. BAGLEY. U. S. Geological Survey Bulletin 657. Pp. 88, with maps, tables, and illustrations. 1917.

This bulletin treats of the use made of the panoramic camera in connection with the planetable in Alaskan topographic surveys, describes the supplementary instruments and devices employed for constructing topographic maps, and contains maps resulting from the method. Though engineers have for many years recognized the possible value of the panoramic camera in topographic surveying, there is no other record of its having been systematically employed in topographic surveying. The conclusions indicate that the method is valuable in rugged mountains, not only because it reduces the final cost of the map, but because in certain classes of reconnaissance surveys where time for the field work is limited there is a distinct gain in the quantity of the results.

The principles governing the use of photographs taken from aircraft are briefly set forth in the chapter on the application of photogrammetry to aerial surveys. The increasing importance of this branch of photographic surveying to certain engineering and surveying practices gives it place as a subject that needs much immediate investigation. The chief purpose of the notes is to call attention to this need and to indicate a possible method of procedure. J. W. B.

REFERENCES

Under this heading it is proposed to include, by author, title, and citation, references to all scientific papers published in or emanating from Washington. It is requested that authors cooperate with the editors by submitting titles promptly, following the style used below. These references are not intended to replace the more extended abstracts published elsewhere in this JOURNAL.

ORNITHOLOGY

OBERHOLSER, H. C. *The birds of the Anamba Islands.* Bull. U. S. Nat. Mus., No. 98. Pp. i-v, 1–75, pls. 1, 2. June 30, 1917. (Fifty-six species and subspecies are treated, including nineteen new forms. *Sterna melanauchen provida*, from the Seychelles, and *Ceyx tridactylus macrocarus*, from the Nicobars, are also described.—C. W. R.)

OBERHOLSER, H. C. *Notes on North American birds. II.* Auk, **34:** 321–329. July, 1917. (Notes on the status of nine species and subspecies.—C. W. R.)

OBERHOLSER, H. C. *A synopsis of the races of* Bombycilla garrula (*Linnaeus*). Auk, **34:** 330–333. July, 1917. (Recognizes three forms of this species.—C. W. R.)

OBERHOLSER, H. C. *Autumn water-bird records at Washington, D. C.* Proc. Biol. Soc. Wash., **31:** 121. July 27, 1917. (Adds one species to the local list, and gives additional records of interest.—C. W. R.)

OBERHOLSER, H. C. Piranga rubra rubra *in Colorado.* Proc. Biol. Soc. Wash., **30:** 122. July 27, 1917.

OBERHOLSER, H. C. *Mutanda ornithologica. II.* Proc. Biol. Soc. Wash., **30:** 125, 126. July 27, 1917. (Six changes of names, of which *Micropsitta chloroxantha* is new.—C. W. R.)

OLDYS, H. *Rhythmical singing of veeries.* Auk, **33:** 17–21. January, 1916.

OLDYS, H. *Are our birds decreasing or increasing?* Amer. Mus. Journ., **16:** 199, 200. March, 1916.

OLDYS, H. *The meaning of bird music.* Amer. Mus. Jour., **17:** 123–127. February, 1917.

OLDYS, H. *Starlings nesting near Washington, D. C.* Auk, **34:** 338. July, 1917.

OLDYS, H. *Plumage importation in England.* Auk, **34:** 369. July, 1917. (Importation suspended during period of the war.—C. W. R.)

PALMER, T. S. *In memoriam: Theodore Nicholas Gill.* Auk, **32:** 391–405, pl. 26. October, 1915.

PALMER, T. S. *The type locality of* Colaptes cafer. Auk, **33:** 322–324. July, 1916. (Nootka Sound should replace Mexico as type locality of this species. —C. W. R.)

PALMER, T. S. *Clarence Henry Morrell—a correction.* Auk, **34:** 93. January, 1917.

PALMER, T. S. *In memoriam: Wells Woodbridge Cooke.* Auk, **34:** 119–132, pl. 2. April, 1917.

PETERS, J. L. *The Porto Rican grasshopper sparrow.* Proc. Biol. Soc. Wash., **30:** 95, 96. May 23, 1917. (Describes *Ammodramus savannarum borinquensis.*—C. W. R.)

RICHARDS, T. W. *Breeding of* Tiaris canora, *and other notes from the U. S. Naval Station, Guantanamo Bay, Cuba.* Condor, **18:** 145–151, figs. 40–42. July 20, 1916.

RICHMOND, C. W. *An early record of American scoter for California.* Condor, **18:** 83. March 30, 1916.

RICHMOND, C. W. *The earliest name for the nighthawk.* Auk, **34:** 88, 89. January, 1917. (*Caprimulgus minor* Forster, 1771, antedates *C. virginianus* Gmelin, 1789.—C. W. R.)

RICHMOND, C. W. *A new name for* Onychospiza *Prjevalski.* Auk, **34:** 89. January, 1917. (*Onychostruthus* is suggested in place of the above preoccupied name.—C. W. R.)

RICHMOND, C. W. *"One of the rarest birds."* Auk, **34:** 215–217. April, 1917. (Note on *Callaeops periophthalmicus,* which is identified with *Terpsiphone nigra.*—C. W. R.)

RICHMOND, C. W. *Explorations in Santo Domingo.* Smiths. Misc. Coll., **66**[17]: 36–39, figs. 38, 39. April, 1917.

RICHMOND, C. W. *The Cape May warbler at Washington, D. C., in winter.* Auk, **34:** 343. July, 1917.

RICHMOND, C. W. *Descriptions of two new birds from Haiti.* Smiths. Misc. Coll., **68**[7]: 1–3. July 12, 1917. (*Nyctibius griseus abbotti* and *Vireo crassirostris tortugæ* are diagnosed as new.—C. W. R.)

RIDGWAY, R. *Bird studies in Illinois.* Smiths. Misc. Coll., **65**[6]: 40. 1915.

RIDGWAY, R. *The birds of North and Middle America. Part VII.* Bull. U. S. Nat. Mus., No. 50, Pt. 7. Pp. i-xii, 1–543, pls. 1–24. May 5, 1916. (Embraces the cuckoos, parrots, and pigeons.—C. W. R.)

RILEY, J. H. *Description of a new hazel grouse from Manchuria.* Proc. Biol. Soc. Wash., **29:** 17, 18. January 25, 1916. (Describes *Tetrastes bonasia amurensis.*—C. W. R.)

RILEY, J. H. *Two new ralliformes from tropical America.* Proc. Biol. Soc. Wash., **29:** 103, 104. June 6, 1916. (*Fulica americana grenadensis* and *Crecriscus murivagans* are here described.—C. W. R.)

RILEY, J. H. *Three remarkable new species of birds from Santo Domingo.* Smiths. Misc. Coll., **66**[15]: 1, 2. December 1, 1916. (Describes *Asio noctipetens, Brachyspiza antillarum,* and *Loxia megaplaga.*—C. W. R.)

RILEY, J. H. *An unrecorded bird from the Bahamas.* Auk, **34:** 209. April, 1917. (*Tyrannus tyrannus* is new to the islands.—C. W. R.)

RILEY, J. H. *A bird new to the North American fauna.* Auk, **34:** 210. April, 1917. (*Pinicola enucleator kamtschathensis* is recorded from the Pribilofs.—C. W. R.)

SHUFELDT, R. W. *Science, ornithology, and the war.* Wilson Bull., **27:** 344–347. June, 1915.

SHUFELDT, R. W. *Owls, as regarded by the scientist, the agriculturist, and the sportsman.* Wilson Bull., **27:** 393–403, figs. 1–5. September, 1915.

SHUFELDT, R. W. *Song sparrow, thrush, and owl notes.* Wilson Bull., **27:** 415–417. September, 1915.

SHUFELDT, R. W. *Comparative osteology of Harris's flightless cormorant* (Nannopterum harrisi). Emu, **15**: 86–114, pls. 15–19. October, 1915.

SHUFELDT, R. W. *Comparative osteology of certain rails and cranes, and the systematic positions of the super-suborders gruiformes and ralliformes.* Anat. Record, **9**: 731–750, figs. 1–9. October, 1915.

SHUFELDT, R. W. *On a restoration of the base of the cranium of* Hesperornis regalis. Bull. Amer. Paleontology, No. 25. Pp. 75–82. December 15, 1915.

SHUFELDT, R. W. *On the position of the Aramidae in the system.* Auk, **33**: 108–111. January, 1916.

SHUFELDT, R. W. *Shall we save the quail from extermination?* Our Dumb Friends, **1916**: 147, 148. March, 1916.

SHUFELDT, R. W. *A fossil feather from Taubaté.* Auk, **33**: 206, 207. April, 1916.

SHUFELDT, R. W. *Eggs of reptiles and birds compared, with some unusual examples of the latter.* Emu, **15**: 225–234. pls. 37–41. April, 1916.

SHUFELDT, R. W. *Osteology of* Palaeornis, *with other notes on the genus.* Trans. Roy. Soc. South Africa, **5**: 575–591, pls. 39–41. June, 1916.

SHUFELDT, R. W. *The significance of the osteological characters of the Chionides.* Auk, **33**: 352, 353. July, 1916.

SHUFELDT, R. W. *New extinct bird from South Carolina.* Geol. Mag., Decade VI, **6**: 343–347. August, 1916. (*Palaeochenoides mioceanus* is described as a new genus and species.—C. W. R.)

SHUFELDT, R. W. *Present work of Gerhard Heilmann.* Auk, **33**: 457, 458. October, 1916.

SHUFELDT, R. W. *Fossil birds' eggs.* Emu, **16**: 80–91, pls. 21–25. October, 1916.

SHUFELDT, R. W. *The bird-caves of the Bermudas and their former inhabitants.* Ibis, ser. X, **4**: 623–635, pl. 20. October, 1916. (*Puffinus mcgalli, P. parvus,* and *Æstrelata vociferans* are diagnosed as new, based on their osseous remains.—C. W. R.)

SHUFELDT, R. W. *Report on fossil birds from Vero, Florida.* Journ. Geol., **25**: 18, 19. January-February, 1917. (*Querquedula floridana, Larus vero,* and *Ardea sellardsi* are named as new.—C. W. R.)

SHUFELDT, R. W. *Efforts to save the birds.* Amer. Forestry, **23**: 103, 104, 2 figs. February, 1917.

SUMMERS, E. *Notation of bird songs and notes.* Auk, **33**: 78–80. January, 1916.

TODD, W. E. C. *Preliminary diagnoses of fifteen apparently new neotropical birds.* Proc. Biol. Soc. Wash., **29**: 95–98. June 6, 1916.

TODD, W. E. C. *Preliminary diagnoses of apparently new birds from Colombia and Bolivia.* Proc. Biol. Soc. Wash., **30**: 3–6. January 22, 1917. (Seventeen new species and subspecies are here diagnosed, briefly.—C. W. R.)

TODD, W. E. C. *New genera, species, and subspecies of South American birds.* Proc. Biol. Soc. Wash., **30**: 127–129. July 27, 1917. (*Idiospiza* and *Pœcilurus* are new genera; ten new species and subspecies are also diagnosed.—C. W. R.)

TROXELL, E. L. *Oligocene fossil eggs.* Journ. Wash. Acad. Sci., **6**: 422–425, figs. 1–5. July 19, 1916. (Two birds' eggs are described from the Oligocene bad-lands near Harrison, Nebraska.—C. W. R.)

WETMORE, A. *Birds of Porto Rico.* Bull. U. S. Dep. Agr., No. 326. Pp. 1–140, pls. 1–10. March 24, 1916.

WETMORE, A. *The speed of flight in certain birds.* Condor, **18:** 112, 113. June 8, 1916. (Seven species, representing seven families, varied from 22 to 28 miles per hour.—C. W. R.)

WETMORE, A. *The birds of Vieques Island, Porto Rico.* Auk, **33:** 403–419. October, 1916. (Sixty-five species are recorded.—C. W. R.)

WETMORE, A. *Canaries: their care and management.* U. S. Department of Agriculture, Farmers' Bulletin, No. 770. Pp. 1–20, figs. 1–5. December, 1916.

WETMORE, A. *The birds of Culebra Island, Porto Rico.* Auk, **34:** 51–62. January, 1917. (Enumerates fifty-four species.—C. W. R.)

WETMORE, A. *A new cuckoo from New Zealand.* Proc. Biol. Soc. Wash., **30:** 1, 2. January 22, 1917. (Describes *Urodynamis taitensis pheletes.*—C. W. R.)

WETMORE, A. *On certain secondary sexual characters in the male ruddy duck,* Erismatura jamaicensis (Gmelin). Proc. U. S. Nat. Museum, **52:** 479–482, fig. 1. February 8, 1917. (Describes the tracheal air-sac and neighboring structures.—C. W. R.)

WETMORE, A. *An abnormal egg of* Fulica americana. Condor, **19:** 65, 66, fig. 24. March 15, 1917. (Describes and figures an abnormal egg of the coot.—C. W. R.)

WETMORE, A. *A new honey-eater from the Marianne Islands.* Proc. Biol. Soc. Wash., **31:** 117, 118. May 23, 1917. (Describes *Myzomela rubratra saffordi.*—C. W. R.)